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PROPOSED USA STANDARD

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FOREWORD

(This foreword is not part of the USA Standard Alphanumeric Keyboard Arrangements accommodating the Character Sets of the USA Standard Code for Information Interchange and USA Standard Character Set for Optical Character Recognition.)

These USA Standard Arrangements are intended principally for typewriter-like data communications and data processing alphanumeric keyboards implementing the Character Sets of the USA Standard Code for Information Interchange (USASCII-USAS X3.4-1968) and the USA Standard Character Set for Optical Character Recognition (USASCSOCR-USAS-X3.17-1966).

These keyboard arrangements were developed from a study of keyboards already in use by millions of trained operators in the teleprinter, typewriter and related fields. Also taken into consideration were the USA Standard Typewriter Keyboards (USAS X4.7-1966) and the applicable standards work being carried out internationally.

This standard was approved as a USA Standard by the United States of America Standards Institute on

Suggestions for improvement gained in the use of the standard will be welcomed. They should be sent to the United States of America Standards Institute, 10 East 40th Street, New York, New York 10016.

PROPOSED
USA STANDARD
ALPHANUMERIC KEYBOARD ARRANGEMENTS
ACCOMMODATING THE CHARACTER SETS OF
THE USA STANDARD CODE FOR INFORMATION
INTERCHANGE AND USA STANDARD CHARACTER
SET FOR OPTICAL CHARACTER RECOGNITION

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USA STANDARD

ALPHANUMERIC KEYBOARD ARRANGEMENTS
ACCOMMODATING THE CHARACTER SETS OF
THE USA STANDARD CODE FOR INFORMATION
INTERCHANGE AND USA STANDARD CHARACTER
SET FOR OPTICAL CHARACTER RECOGNITION

1. Scope

This standard specifies the assignment of the characters of the (1) USASCII (USAS X3.4-1968) and (2) USASCSOCR (USAS X3.17-1966) Character Sets to the keys of typewriter-like keyboard arrangements.

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2. STANDARD KEYBOARD ARRANGEMENTS

- 2.1 Figures 1 and 2 show the standard arrangements of the keys and the graphics assigned to them.
 - 2.1.1 In Figures 1 and 2, the keys labelled with the letters of the alphabet are intended to produce lower case letters in the unshifted mode and upper case letters in the shifted mode. The other keys in these two Figures are intended to produce the lower graphic as shown in the key in the unshifted mode and the upper graphic as shown in the key in the shifted mode.
 - 2.1.2 When one of the two characters normally assigned to a key is omitted, the remaining character may optionally be assigned in both modes.
 - 2.1.3 The means by which keyboards utilizing these arrangements are to encode the characters is not prescribed.
 - 2.1.4 No standard locations are defined herein for function keys that may be required on a keyboard device, other than 2 SHIFT KEYS, 1 SHIFT LOCK KEY and CONTROL FUNCTION KEY(s) which, when utilized, shall be outboard of the two SHIFT KEYS.
 - 2.1.5 Inboard and outboard locations are provided for the Control characters of the United States of America Standard Code for Information Interchange Character Set. The "inboard" control locations shall be on the alphanumeric keys bit paired with the characters as shown in 2.1.6. The function of the CONTROL FUNCTION KEY(s) is to set the keyboard in the control mode while it is operated (depressed). It will cause those keys having control character assignments (2.1.6) to generate their respective United States of America Standard Code for Information Interchange Control Codes regardless of the state of the SHIFT or SHIFT LOCK KEY. The areas designated for "outboard" controls are located to the left and to the right of the alphanumeric area. The outboard control area is undefined in the exact placement of keys because it will vary with application. Depression of an outboard key with a single control character on it will generate its respective code regardless of the state of the SHIFT or SHIFT LOCK KEY. Outboard keys may have two control characters, one in unshifted mode, the other in shifted mode, providing the provisions of 2.2 are not violated.

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- 2.1.6 If an inboard control mode is provided, the following pairings will be observed:

NUL @	DLE P
SOH A	DC1 Q
STX B	DC2 R
ETX C	DC3 S
EOT D	DC4 T
ENQ E	NAK U
ACK F	SYN V
BEL G	ETB W
BS H	CAN X
HT I	EM Y
LF J	SUB Z
VT K	ESC [
FF L	FS \
CR M	GS]
SO N	RS ^
SI O	US _

- 2.1.7 The character DEL (Delete) when used on a key by itself shall be located in the outboard control area.
- 2.1.8 This standard is not intended to depreciate the assignment of a control both to a key prescribed herein and also to another key in a position not assigned in the standard arrangements.
- 2.1.9 A recommended location for a numeric cluster is adjacent to the most frequently used outboard controls to the right of the alphanumeric area.
- 2.2 The keyboard illustrated in Figure 1 and all its permissible derivatives, as herein prescribed, shall observe logical bit pairing rules. Specifically, the code relation between the upper shift character and the lower shift character of any given key shall consist only of inversion of bit 5 or inversion of bit 6.
- 2.2.1 In Figure 1, key DR8 produces underline in both the shifted and unshifted modes, but may optionally produce DEL (Delete) in the shifted mode and underline in the unshifted mode.
- 2.2.2 An option which provides both upper case and lower case commas and periods is obtained either by excluding the less than and greater than or reassigning these two characters to two alternate locations. Examples of such an assignment would be ER7, ER8, DR6, DR7, DR8, CR7 or elsewhere.

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- 2.2.3 A keyboard of fewer keys or characters than are encompassed by this standard is not in conflict with this standard providing the position assignment of the remaining characters conforms to the following rules:

omit Key DR8 to obtain a 47 key keyboard,
or
omit Keys DR8 and ER8 to obtain a 46 key keyboard,
or
omit Keys DR8, ER8 and CR7 to obtain a 45 key keyboard,
or
omit Keys DR8, ER8, CR7, and DR7 to obtain a 44 key keyboard.

Any pair of graphic characters allocated to the omitted keys may either be omitted or may be reallocated to any one of the following keys: ER7, ER8, DR6, DR7 or CR7. Any pair of characters replaced by a pair of characters from one of the omitted keys is lost. It cannot be reallocated to another key.

- 2.2.4 The specified locations for the 6 characters of the USA Standard Character Set for Optical Character Recognition (X3.17-1966) in Figure 1 that are not in USASCII are as follows:

Key Position	Standard Character (USASCII)	Substitute Character (USASCSOCR)
EL5	I	I
*BR3	<	J
ER6	=	K
*BR4	>	L
DR9	None	CE** GE**

* or as specified in Paragraph 2.2.2

** at this writing these characters will be included in a proposed revision

- 2.3 The keyboard illustrated in Figure 2 resembles as closely as possible, the electric typewriter arrangement as designated in Document X4.7-1966.
- 2.3.1 A keyboard of fewer keys or characters than are encompassed by this standard is not in conflict with this standard providing the position assignment of the remaining characters conforms to the following rules:

omit ER8 to obtain a 46 key keyboard
omit ER8, CR7 to obtain a 45 key keyboard
omit ER8, CR7 and DR7 to obtain a 44 key keyboard

Any of the graphic characters allocated to the omitted keys may either be omitted or may be reallocated to any of the following keys: ER8, CR7, DR7 or DR6. Any character replaced by a character from one of the omitted keys is lost. It cannot be reallocated to another key.

Standard 44 key arrangements may have on key DR6 any two of the omitted characters from ER8, DR7, CR7, DR6, BR3 or BR4.

- 2.3.2 An option which provides both upper case and lower case commas and periods is obtained either by excluding the less than and greater than or reassigning these two characters to an alternate location(s). Examples of such an assignment would be ER7, ER8, DR6, DR7, DR8, CR7 or elsewhere.
- 2.3.3 The specified locations for the 6 characters of the USA Standard Character Set for Optical Character Recognition (X3.17-1966) in Figure 2 that are not in USASCII are as follows:

Key Position	Standard Character (USASCII)	Substitute Character (USASCSOCR)
EL5	!	⌈
EL4	@	⌋
EL3	#	⌋
ER1	~	⌋
DR6	~	CF**
DR6	~	GE**

** at this writing these characters will be included in a proposed revision

- 2.3.4 To provide complete compatibility with X4.7-1966 Preferred Keyboard Arrangement, an optional arrangement of Figure 2 provides these substitutions: c for ! on ER1, 1/4 for ~ on DR6, and 1/2 for ^ on DR6.

3. Definitions

Alphanumeric - A descriptive term used to define a set containing the letters of an ethnic alphabet, the digits 0 (ZERO) through 9, and punctuation marks or special symbols.

Control Character - A functional character, as distinct from a graphic character, which is intended to facilitate information interchange by controlling or modifying the function of machines or systems. Control characters are intended to be interpreted by machines rather than human beings and are, therefore, normally nonprinting characters. In the USASCII code table they comprise Columns 0 and 1.

Control Mode - The condition of the keyboard when a CONTROL FUNCTION KEY is operated. In this mode, it will cause those keys having control characters to generate their respective control code regardless of the status of the SHIFT or SHIFT LOCK key.

Function Key - A key, such as the SHIFT or CONTROL key which initiates or modifies a machine function, but which does not generate or represent a coded character in the USA Standard Code for Information Interchange.

Graphic Character - A character intended to be written, printed or otherwise displayed in a form which can be read by human beings. In the USASCII code table they comprise Columns 2 through 7, excluding DEL (position 7/15). Note that space is considered to be a graphic character.

Inboard Controls - Those controls that are positioned on keys that normally contain one or both of the unshifted and shifted graphics in the USASCII code. These controls are operated in conjunction with a CONTROL FUNCTION key.

Keyboard - That area of the device in which the keys associated with characters are arranged.

Keyboard Arrangement - The positioning of keys with relation to each other and their association with specific characters.

Outboard Controls - Those controls that are positioned on keys by themselves and do not operate in conjunction with a CONTROL FUNCTION key.

Shifted Mode - The condition of the keyboard when a SHIFT key is operated. In this mode, the alphabetic keys are associated with the upper-case letters, and other keys with the corresponding upper graphic symbol.

Unshifted Mode - The condition of the keyboard when the SHIFT keys are not operated. In this mode, the alphabetic keys are associated with the lower-case letters, the numeric keys with the numerals and other keys with their corresponding lower graphic symbol.

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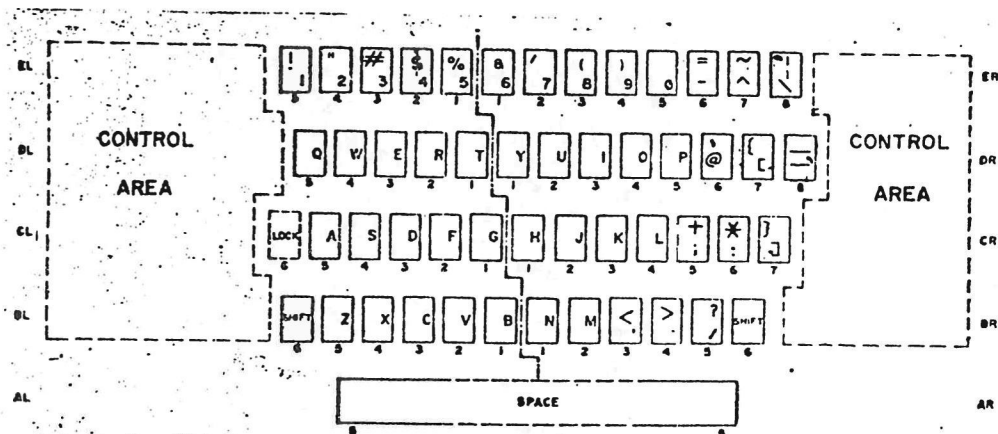


FIGURE 1
LOGICAL BIT PAIRING

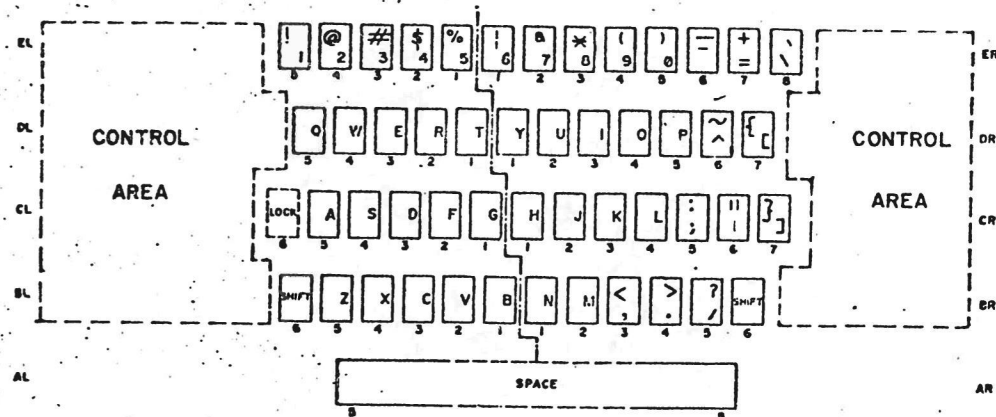


FIGURE 2
TYPEWRITER PAIRING

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APPENDIX

(This appendix is not a part of the USA Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of the USA Standard Code for Information Interchange and USA Standard Character Set for Optical Character Recognition, but is included to facilitate its use.)

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A1. INTRODUCTION

This appendix to the USA Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of the USA Standard Code for Information Interchange and USA Standard Character Set for Optical Character Recognition, contains the criteria and other design considerations that were used in the development of the Standard.

A2. CRITERIA

The following criteria were adopted (not listed in order of priority) to reflect the needed transitions from historically developed divergent keyboard designs to a standard that would be compatible with the USASCII and USASCSOCR character sets. Not all criteria have been satisfied by this standard.

- A2.1 The standard should exclude physical characteristics associated with keyboards other than the nominal relative location of the keys.
- A2.2 The keyboard arrangement should accommodate all 128 (graphic and control) USASCII characters and should take into account the needs of USASCSOCR characters.
- A2.3 The location of a specific character should remain unchanged in keyboard arrangements accommodating fewer than 128 USASCII characters.
- A2.4 The keyboard arrangement should -
 - A2.4.1 Facilitate simplicity of design
 - A2.4.2 provide ease of operation
 - A2.4.3 minimize operator training and retraining
 - A2.4.4 be acceptable for international standardization
 - A2.4.5 have maximum resemblance to present office electric typewriter, data communications and data processing keyboard arrangements
 - A2.4.6 minimize the total number of graphic keys
 - A2.4.7 minimize the total number of function keys

A3. DISCUSSION OF CRITERIA

- A3.1 In order to provide an all inclusive standard, all 128 USASCI characters have been assigned. The 95 USASCI graphics (space included) have been assigned in a 48 key arrangement (Figure 1). The 32 Control characters plus Delete have been assigned general areas. Provisions have been made to accommodate the 6 OCR characters (see ** note on Page 8) not contained in USASCI.
- A3.2 In order to provide an all inclusive keyboard arrangement compatible with X4.7-1966, it was necessary to substitute the USASCI graphics vertical line, tilde and circumflex for the c, 1/4 and 1/2 symbols of X4.7-1966. This substitution was not considered detrimental to good keyboard practice and resulted in a 47 key arrangement.
- A3.3 Both Figure 1 and Figure 2 of this standard are in complete agreement with Document ISO/TC95/SC14-61E, Resolution 2 - General Basic Layout, Figure 1, Page 23. Also, Figure 1 is in agreement with Document ISO/TC95/SC14-61E, Resolution 3 - International Coded Keyboard, Figure 2, Page 24; except only for the location of equal and underscore. Figure 1 of this standard is the recommended keyboard arrangement to the International Organization for Standardization (ISO) for information interchange.
- A3.4 Consideration was given to incorporating the last nine characters (U through Y) for international consideration contained in Appendix B of USAS X3.17-1966 in the keyboard proposal. However, since they are not a part of the USASCSOCR standard and data concerning frequency of usage of these characters were not available it was decided that it would be impractical to include them in any proposed USA STANDARD.

A4. SPECIFIC DESIGN CONSIDERATIONS FOR ARRANGEMENT OF KEYBOARDS

- A4.1 It was apparent that a standard positional notation was needed for easy reference to indicate key positions on which graphics were to be placed. The notational system used is included as a part of this standard.
- A4.2 A review was made of designation of keys in the USA and other national and international standards for keyboard arrangements, e.g., Document X4-A9.1/160, July 10, 1967, Document X4-A9.2/28, April 5, 1967, USA Standard X4.7-1966, UNIPREA Document 10128-TORINO-1968-06, ISO/TC95/SC14. No general agreement for key designations could be found among these and other standard documents, nor could there be found any agreement in communities concerned with keyboards, such as the industrial, educational, governmental, etc.

With these facts in mind, this key designation system has been developed to allow the expansion of the keyboard area to any size without bringing about inconsistencies in key designations. This, in turn, will allow efficient communication either by means of written documents or by way of oral instructions between those who develop keyboard arrangements, between those who are required to consider the specifications of devices with keyboards and have a need to minimize the ambiguity as to the location of given keys and between those who are to learn the operation of devices with keyboards.

- A4.3 After a thorough analysis of all (national and international) keyboard devices, it was decided that a four-row arrangement was the most practical approach for implementing the character sets.
- A4.4 The "QWERTY" or "Sholes" keyboard arrangement of the alphabet that has evolved over the years was used as a basis for the standard. In addition to the many typewriters in use, this keyboard arrangement has also been used by many teleprinters and similar alphabet keyboard devices. As a result, much time and money has been invested for training and texts for operating keyboards using this arrangement.
- A4.5 The arrangement of the USASCI code table (see Figure A1) intentionally makes practical the pairing of corresponding characters of Columns 2 and 3, Columns 4 and 6 and Columns 5 and 7, so that, in a keyboard giving a binary coded output, the inversion of a single bit (b5 or b6, as appropriate) can effect the "shift" for any key. The standard arrangement in Figure 1 follows such a pairing. When a shift key is operated, the appropriate bit is changed from "1" to "0" except for the keys bearing the following characters:

}	{	!	~	=	'	<	>	?
]	[\	^	-	@	,	.	/

(key positions CR7, DR7, ER8, ER7, ER6, DR6, BR3, BR4 and BR5) where inversion is of the opposite sense. These nine were so arranged owing to the relatively higher usage of

]	[\	^	-	@	,	.	/
---	---	---	---	---	---	---	---	---

SP (space) was not paired with zero due to the severe conflict this would have produced with present practice. Underline is normally unpaired, however, DEL (Delete), its logical mate, is included in this arrangement as provided in Paragraph 2.2.1 (Figure A2 summarizes the relationships for the arrangement in Figure 1.)

- A4.6 The standard arrangement in Figure 2 follows the arrangement specified in USAS X4.7-1966 plus the addition of the USASCI graphics not covered by that standard. Figure A3 summarizes the relationships for the arrangement in Figure 2.

A5. GRAPHIC SUBSTITUTION

Within any particular application, equipment configuration or closed system, it may be necessary to substitute graphics. For example, some applications and systems may require special graphic symbols. Design efforts for the standard keyboard arrangement included consideration of these types of adaptations.

- A5.1 This standard specifies the assignment of the graphic characters of USAS X3.4-1968 and USAS X3.17-1966. Any substitution, except when using the ISO 7-Bit Code (ISO/R 646) in an international environment, will result in a keyboard arrangement which does not conform to this standard.
- A5.2 It is recommended that when a graphic is substituted in the standard keyboard arrangement, the displaced graphic should not be reassigned elsewhere on the standard keyboard. Such a substitute graphic, once assigned, should not be subsequently reassigned elsewhere.

FIGURE A1

USA STANDARD CODE
FOR INFORMATION INTERCHANGE (USASCII)

PER USAS X3.4-1968

b7 b6 b5 Bits					COLUMNS										
b4	b3	b2	b1	row	0	1	2	3	4	5	6	7			
0	0	0	0	0	NUL	DLE	SP	0	⊙	P	'	p			
0	0	0	1	1	SOH	DC1	!	!	A	Q	α	q			
0	0	1	0	2	STX	DC2	"	2	B	R	b	r			
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s			
0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t			
0	1	0	1	5	ENQ	NAK	%	5	E	U	o	u			
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v			
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w			
1	0	0	0	8	BS	CAN	(	8	H	X	h	x		
1	0	0	1	9	HT	EM	)	9	I	Y	i	y		
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z			
1	0	1	1	11	VT	ESC	+	;	K	[k	{			
1	1	0	0	12	FF	FS	,	<	L	\	l	!			
1	1	0	1	13	CR	GS	-	=	M]	m	}			
1	1	1	0	14	SO	RS	.	>	N	^	n	~			
1	1	1	1	15	SI	US	/	?	O	—	o	DEL			

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FIGURE A2
CHARACTER PAIRING RELATIONSHIPS ON
KEYBOARD FOR DATA COMMUNICATIONS AND DATA PROCESSING ARRANGEMENTS
(FIGURE 1)

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UNSHIFTED			SHIFT			CONTROL		
BIT CONDITION B ₇ B ₆ B ₅	GRAPHIC REPRESENT.	KEY POS- ITION NUMBER	BIT CONDITION B ₇ B ₆ B ₅	GRAPHIC REPRESENT.	KEY POS- ITION NUMBER	BIT CONDITION B ₇ B ₆ B ₅	CONTROL REPRESENT.	KEY POS- ITION NUMBER
1 0 0	0	DR6	1 1 0	1		0 0 0	NUL	
1 1 0	a	CL5	1 0 0	A		0 0 0	SOH	
1 0 1	b	BL1	1 0 0	B		0 0 0	STX	
1 1 1	c	BL3	1 0 0	C		0 0 0	ETX	
1 0 0	d	CL3	1 0 0	D		0 0 0	EOT	
1 1 0	e	DL3	1 0 0	E		0 0 0	ENQ	
1 0 1	f	CL2	1 0 0	F		0 0 0	ACK	
1 1 1	g	CL1	1 0 0	G		0 0 0	BEL	
1 0 0	h	CR1	1 0 0	H		0 0 0	BS	
1 1 0	i	DR3	1 0 0	I		0 0 0	HT	
1 0 1	j	CR2	1 0 0	J		0 0 0	LF	
1 1 1	k	CR3	1 0 0	K		0 0 0	VT	
1 0 0	l	CR4	1 0 0	L		0 0 0	FF	
1 1 0	m	BR2	1 0 0	M		0 0 0	CR	
1 0 1	n	BR1	1 0 0	N		0 0 0	SO	
1 1 1	o	DR4	1 0 0	O		0 0 0	SI	
1 0 0	p	DR5	1 0 1	P		0 0 0	DLE	
1 1 0	q	DL5	1 0 1	Q		0 0 0	DC1	
1 0 1	r	DL2	1 0 1	R		0 0 0	DC2	
1 1 1	s	CL4	1 0 1	S		0 0 0	DC3	
1 0 0	t	DL1	1 0 1	T		0 0 0	DC4	
1 1 0	u	DR2	1 0 1	U		0 0 0	NAK	
1 0 1	v	BL2	1 0 1	V		0 0 0	SYN	
1 1 1	w	DL4	1 0 1	W		0 0 0	ETB	
1 0 0	x	BL4	1 0 1	X		0 0 0	CAN	
1 1 0	y	DR1	1 0 1	Y		0 0 0	EH	
1 0 1	z	BL5	1 0 1	Z		0 0 0	SUB	
1 1 1		DR8	1 0 1			0 0 0	US	
0 0 0	0 (ZERO)	ER5	NOT PAIRED			NP	NP	
0 0 1	1	EL5	NOT PAIRED			NP	NP	
0 1 0	2	EL4	NOT PAIRED			NP	NP	
0 1 1	3	EL3	NOT PAIRED			NP	NP	
1 0 0	4	EL2	NOT PAIRED			NP	NP	
1 0 1	5	EL1	NOT PAIRED			NP	NP	
1 1 0	6	ER1	NOT PAIRED			NP	NP	
1 0 1	7	ER2	NOT PAIRED			NP	NP	
1 1 1	8	ER3	NOT PAIRED			NP	NP	
1 0 0	9	ER4	NOT PAIRED			NP	NP	
1 1 0	:	CR6	NOT PAIRED			NP	NP	
1 0 1	;	CR5	NOT PAIRED			NP	NP	
1 1 1	.	BR3	NOT PAIRED			NP	NP	
1 0 0	/	ER6	NOT PAIRED			NP	NP	
1 1 0	~	BR4	NOT PAIRED			NP	NP	
1 0 1	^	BR5	NOT PAIRED			NP	NP	
1 1 1	~	ER7	NOT PAIRED			NP	NP	
1 0 0	[	ER8	NOT PAIRED			NP	NP	
1 0 1	\	DR7	NOT PAIRED			NP	NP	
1 1 1	]	CR7	NOT PAIRED			NP	NP	

NOTES:

① IF OPTION OF
2.2.1
IS CHOSEN
SHIFTED MODE IS
B₇ B₅ B₅ (DELETE)
1 1 1

② NP = NOT PAIRED

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FIGURE A3
CHARACTER PAIRING RELATIONSHIPS ON
KEYBOARD FOR TYPEWRITER-LIKE ALPHANUMERIC ARRANGEMENTS
(FIGURE 2)

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KEY POSITION NUMBER	UNSHIFTED			SHIFT			CONTROL		
	BIT CONDITION B ₁ B ₂ B ₃ B ₄ B ₅ B ₆ B ₇	GRAPHIC REPRESENT.	KEY POS- ITION NUMBER	BIT CONDITION B ₁ B ₂ B ₃ B ₄ B ₅ B ₆ B ₇	GRAPHIC REPRESENT.	KEY POS- ITION NUMBER	BIT CONDITION B ₁ B ₂ B ₃ B ₄ B ₅ B ₆ B ₇	CONTROL REPRESENT.	KEY POS- ITION NUMBER
CL5	1 0 0 0 0 1 1	a		1 0 0 0 0 0 1	A		1 0 0 0 0 0 0	SOH	
BL1	0 1 0 0 0 0 1	b		0 1 0 0 0 0 1	B		0 1 0 0 0 0 0	STX	
BL3	1 1 0 0 0 0 1	c		1 1 0 0 0 0 1	C		1 1 0 0 0 0 0	ETX	
CL3	0 0 1 0 0 0 1	d		0 0 1 0 0 0 1	D		0 0 1 0 0 0 0	EOT	
DL3	1 0 1 0 0 0 1	e		1 0 1 0 0 0 1	E		1 0 1 0 0 0 0	ENQ	
CL2	0 1 1 0 0 0 1	f		0 1 1 0 0 0 1	F		0 1 1 0 0 0 0	ACK	
CR1	1 1 1 0 0 0 1	g		1 1 1 0 0 0 1	G		1 1 1 0 0 0 0	BEL	
DR3	0 0 0 1 0 0 1	h		0 0 0 1 0 0 1	H		0 0 0 1 0 0 0	BS	
CR2	1 0 0 1 0 0 1	i		1 0 0 1 0 0 1	I		1 0 0 1 0 0 0	HT	
CR3	1 1 0 1 0 0 1	j		1 1 0 1 0 0 1	J		0 1 0 1 0 0 0	LF	
CR4	0 1 0 1 0 0 1	k		0 1 0 1 0 0 1	K		1 1 0 1 0 0 0	VT	
BR2	1 0 1 1 0 0 1	l		1 0 1 1 0 0 1	L		0 0 1 1 0 0 0	FF	
BR1	0 1 1 1 0 0 1	m		0 1 1 1 0 0 1	M		1 0 0 1 0 0 0	CR	
DR4	1 1 1 1 0 0 1	n		1 1 1 1 0 0 1	N		0 1 1 1 0 0 0	SO	
DR5	0 0 0 0 1 0 1	o		0 0 0 0 1 0 1	O		1 1 1 1 0 0 0	SI	
DL5	1 0 0 0 1 0 1	p		1 0 0 0 1 0 1	P		0 0 0 0 1 0 0	DLE	
DL2	0 1 0 0 1 0 1	q		0 1 0 0 1 0 1	Q		1 0 0 0 1 0 0	DC1	
CL4	1 1 0 0 1 0 1	r		1 1 0 0 1 0 1	R		0 1 0 0 1 0 0	DC2	
DL1	0 0 1 0 1 0 1	s		0 0 1 0 1 0 1	S		1 1 0 0 1 0 0	DC3	
DR2	1 0 1 0 1 0 1	t		1 0 1 0 1 0 1	T		0 0 1 0 1 0 0	DC4	
BL2	0 1 1 0 1 0 1	u		0 1 1 0 1 0 1	U		1 0 1 0 1 0 0	NAK	
DL4	1 1 1 0 1 0 1	v		1 1 1 0 1 0 1	V		0 1 1 0 1 0 0	SYN	
BL4	0 0 0 1 1 0 1	w		0 0 0 1 1 0 1	W		1 1 1 0 1 0 0	ETB	
DR1	1 0 0 1 1 0 1	x		1 0 0 1 1 0 1	X		0 0 0 1 1 0 0	CAN	
BL5	0 1 0 1 1 0 1	y		0 1 0 1 1 0 1	Y		1 0 0 1 1 0 0	EH	
ER5	0 0 0 0 1 0 1	z		0 0 0 0 1 0 1	Z		0 1 0 1 1 0 0	SUB	
EL5	1 0 0 0 1 0 1			1 0 0 0 1 0 1			NP	NP	
EL4	0 1 0 0 1 0 1			0 1 0 0 1 0 1			NP	NP	
EL3	1 1 0 0 1 0 1			1 1 0 0 1 0 1			NP	NP	
EL2	0 0 1 0 1 0 1			0 0 1 0 1 0 1			NP	NP	
EL1	1 0 1 0 1 0 1			1 0 1 0 1 0 1			NP	NP	
ER1	0 1 1 0 1 0 1			0 1 1 0 1 0 1			NP	NP	
ER2	1 1 1 0 1 0 1			1 1 1 0 1 0 1			NP	NP	
ER3	0 0 0 1 1 0 1			0 0 0 1 1 0 1			NP	NP	
ER4	1 0 0 1 1 0 1			1 0 0 1 1 0 1			NP	NP	
ER6	0 1 0 1 1 0 1			0 1 0 1 1 0 1			NP	NP	
ER7	1 0 1 1 1 0 1			1 0 1 1 1 0 1			NP	NP	
ER8	0 0 1 1 1 0 1			0 0 1 1 1 0 1			NP	NP	
DR6	1 0 1 1 1 0 1			1 0 1 1 1 0 1			NP	NP	
DR7	0 1 1 1 1 0 1			0 1 1 1 1 0 1			NP	NP	
CR6	1 1 0 1 1 0 1			1 1 0 1 1 0 1			NP	NP	
CR5	0 1 0 1 1 0 1			0 1 0 1 1 0 1			NP	NP	
CR7	1 0 1 1 1 0 1			1 0 1 1 1 0 1			NP	NP	
BR3	0 0 1 1 1 0 1			0 0 1 1 1 0 1			NP	NP	
BR4	0 1 1 1 1 0 1			0 1 1 1 1 0 1			NP	NP	
BR5	1 1 1 1 1 0 1			1 1 1 1 1 0 1			NP	NP	
BR6	0 1 1 1 1 0 1			0 1 1 1 1 0 1			NP	NP	
BR7	1 1 1 1 1 0 1			1 1 1 1 1 0 1			NP	NP	

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EXPOSITORY REMARKS

ON THE

PROPOSED USA STANDARD

ALPHANUMERIC KEYBOARD ARRANGEMENTS

ACCOMMODATING THE CHARACTER SETS OF

THE USA STANDARD CODE FOR INFORMATION

INTERCHANGE AND USA STANDARD CHARACTER

SET FOR OPTICAL CHARACTER RECOGNITION

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E1. INTRODUCTION

E1.1 These expository remarks relate to the proposed USA Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of USA Standard Code for Information Interchange and USA Standard Character Set for Optical Character Recognition. The historical items, international factors and general and particular considerations bearing on the design, and also the method of reconciling the different requirements of keyboard arrangements to be used in different applications are presented herein.

E2. HISTORY

E2.1 The activity of Subcommittee X4-A9, Keyboard Arrangements, has functioned within the scope and framework of USAS X3.4-1968 and USAS X3.17-1966. In addition, Subcommittee X4-A9 has engaged in close liaison with Subcommittees X3.1, X3.2 and the X4 Subcommittees responsible for typewriters and accounting machines, in an attempt to make keyboard arrangements as effective as possible for a wide variety of keyboard devices and applications using the character sets of USAS CII and USAS CSOCR.

E2.2 As an aid in following the development of the proposed standard keyboard arrangements, Figures E1 - E3 show three widely used arrangements which have evolved in the development of data communication, data processing and typewriter-like keyboards up to the present day. Careful consideration was given to de facto practices in the placement of the alphanumeric characters and the USAS CII code consideration restraints before developing the proposed four-row keyboard arrangement.

E3. FOUR-ROW ARRANGEMENT

E3.1 After a thorough review of all keyboard devices, both national and international, the four-row arrangement was decided upon as the most practical and economical for user and manufacturer. The study included human engineering considerations and de facto practices (typewriter-like devices and teleprinters) in addition to some national keyboard arrangements.

E3.2 Due consideration was given to the historic 5-bit teleprinter practice of a three-row keyboard. However, it was decided that because of the expanded character set, the four-row approach arrangement was appropriate.

E4. INTERNATIONAL CONSIDERATIONS

- E4.1 Serious consideration was given to incorporating international requirements within the hard-core confines of the proposed keyboard arrangements. These consisted of reviewing the "National Usage" characters to determine where best to place them to allow for substitution by national standards organizations, and to determine what characters would be substituted by these same organizations. Earlier in the deliberations, it was decided that it was not desirable to upset the de facto arrangement of alphabet and numerics due to the serious retraining problem that would be produced.
- E4.2 After reviewing the "National Usage" situation, it was decided to forego attempting to satisfy all international requirements because of the burden it places on American operators. To accommodate international requirements, such characters as colon, semicolon, etc., would have to be relocated outside the touch-typing area when the "National Usage" characters are used as alphabetic extenders. Further work on an international basis is continuing.

E5. LOCATION OF NUMERALS

- E5.1 Historically, the top row of the alphanumeric keyboard has been used for numerals, and to avoid the expense of operator retraining, these locations were retained in the proposed standard. With new applications such as data entry coming into general use, the possibility of relocating the numerals into a cluster off to the side is allowed for.

E6. LOCATION OF SPECIAL GRAPHICS

- E6.1 The following comments relate to Figure 1 (logical bit paired arrangement).
- E6.1.1 The status of the semicolon as a "home" position character (right little finger) has become so universal that in spite of its lower incidence of use than the colon its retention in that position (key CR5) was considered mandatory. Since the colon in the USASCII code structure is logically paired with asterisk it was separated from the semicolon and placed on key CR6. The plus sign and the asterisk were placed in the shifted position of the semicolon and colon keys, respectively, because of a 1-bit code difference (bit 5).

- E6.1.2 The comma and period are high usage characters traditionally assigned to keys BR3 and BR4 and often are available in both the unshifted and shifted modes. It was decided to maintain these key locations, but to make these characters normally available only in the unshifted mode so that their logical mates less than (<) and greater than (>) could be combined with them to minimize the number of keys. It was recognized that placing the comma and period in the unshifted position and less than (<) and greater than (>) in the shifted position involves bit 5 inversion from 0-1 rather than 1-0, but it was felt the weight of precedent justified this.
- E6.1.3 Following standard typewriter practice, the question mark and slant share key BR5 with the slant in the unshifted position. As with the period and comma, consideration was given to reversing the positions of the question mark and the slant to avoid a 0-1 inversion of bit 5 but it was decided that the weight of precedent was sufficient to justify keeping the traditional arrangement.
- E6.1.4 Hyphen is the fourth character in which the importance of its traditional placement in the unshifted position was deemed to outweigh the inconvenience of a 0-1 inversion of bit 5. Consequently, hyphen has been given its historical unshifted position on key ER6, with equals taking the upper case position on the same key.
- E6.1.5 Commercial at was placed in the unshifted position of key DR6 because of its greater utility compared to grave accent, and to allow both grave and acute accents to be in the same shift state. This advantage outweighed any disadvantage of a 0-1 inversion of bit 6.
- E6.1.6 Underline was made the sole assignment to key DR8. Its logical mate DEL (Delete) was included in this proposed standard as provided in Paragraph 2.2.1.
- E6.1.7 Circumflex, reverse slash, left bracket and right bracket were placed in the unshifted position of keys ER7, ER8, DR7 and CR7, respectively, because of the greater utility of these characters than their bit shifted counterparts. This advantage outweighed any disadvantage of an 0-1 inversion of bit 6.
- E6.2 The following comments relate to Figure 2 (typewriter paired arrangement).
- E6.2.2 The numeral 1 and graphic 1 were placed in key position EL5 to more closely resemble the arrangement in Figure 1.

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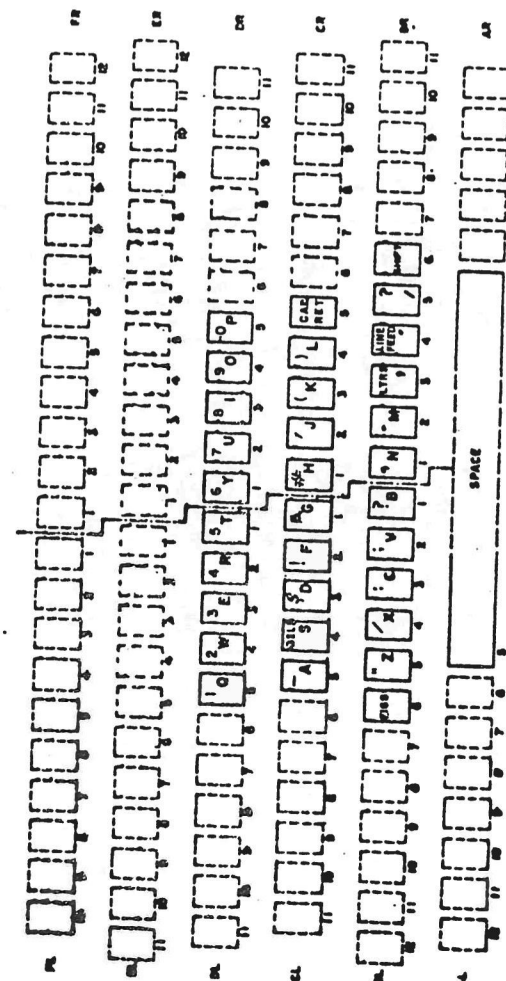
- E6.2.3 The vertical line was placed above the numeral 6 because of the absence of the graphic c.
- E6.2.4 The graphic = and + were placed in ER7 because of traditional typewriter practice.
- E6.2.5 Circumflex (^) and tilde (~) were placed in key position DR6 because of the absence of the graphics 1/4 and 1/2.
- E6.2.6 Right bracket and brace along with left bracket and brace were assigned key positions CR7 and DR7, respectively, to more closely resemble the arrangement in Figure 1.
- E6.2.7 Grave accent was placed in the shifted position of key ER8 with reverse slash in the unshifted mode because of the higher usage of reverse slash.

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FIGURE E1

TYPICAL 3-ROW TELEPRINTER KEYBOARD



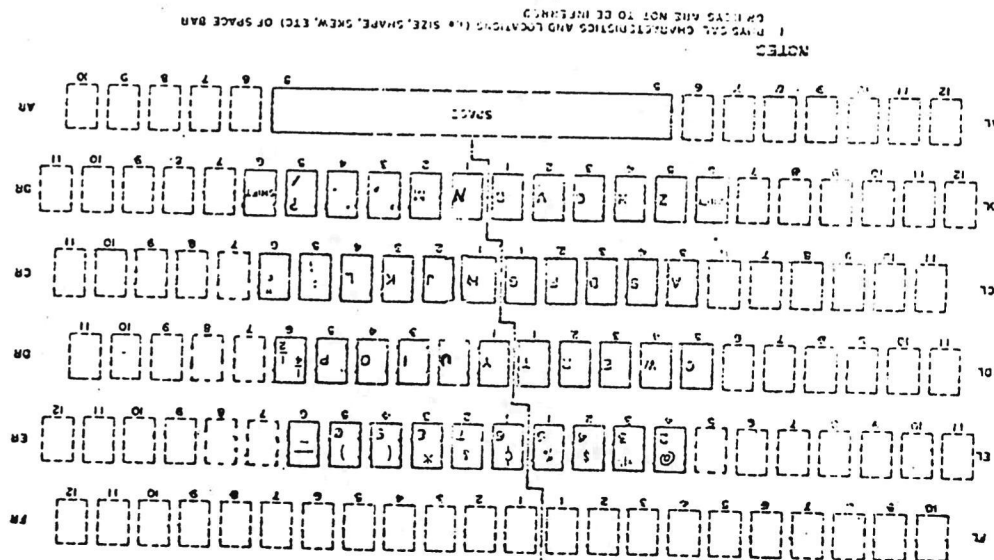
NOTES
1. PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC.) OF SPACE BAR
ON KEYS ARE NOT TO BE INFERRED

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FIGURE E2

USA STANDARD ELECTRIC TYPEWRITER KEYBOARD (PER USAS X4.7-1966)

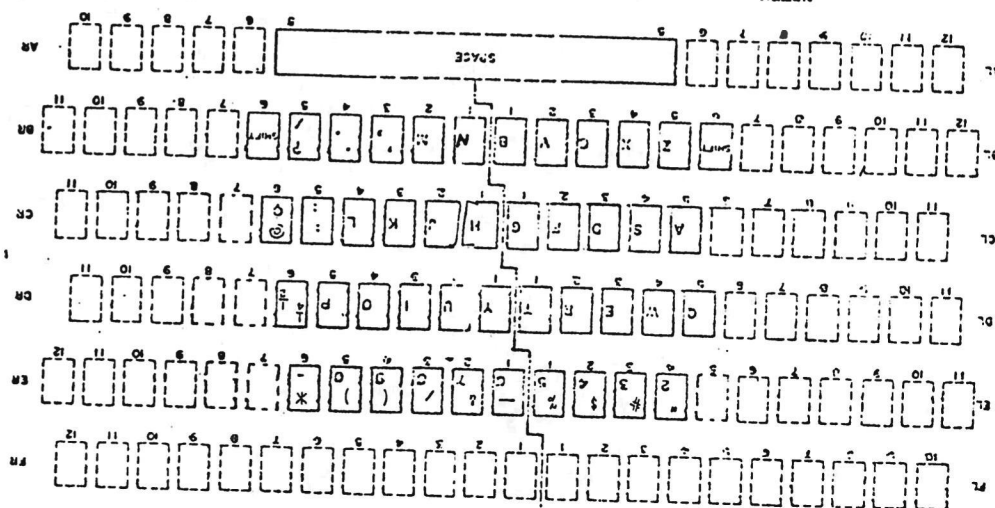


NOTES
1. PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC.) OF SPACE BAR
DIMENSIONS ARE NOT TO BE INFERRED

E-8

FIGURE E3

USA STANDARD MANUAL TYPEWRITER KEYBOARD (PER USAS X4.7-1966)



NOTES
1. PHYSICAL CHARACTERISTICS AND LOCATIONS (i.e. SIZE, SHAPE, SKEW, ETC.) OF SPACE BAR
DIMENSIONS ARE NOT TO BE INFERRED

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